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(71) Applicant : **MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.**
1006, Ohaza Kadoma
Kadoma-shi, Osaka 571 (JP)

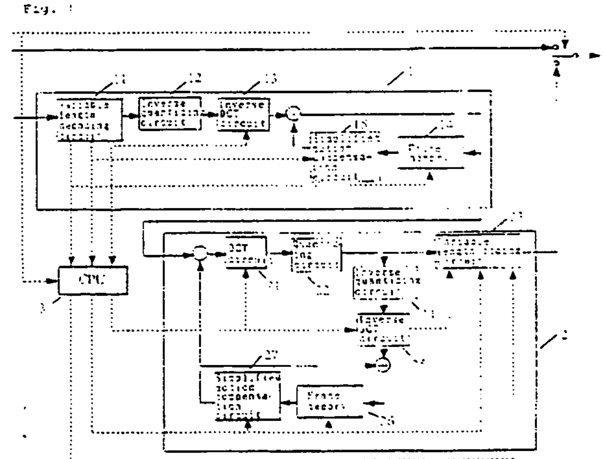
(72) Inventor : **Takahashi, Toshiya**
1-5-107 Akenocho
Takatsuki-shi, Osaka-fu 569 (JP)

(74) Representative : **Crawford, Andrew Birkby et al**
A.A. THORNTON & CO.
Northumberland House
303-306 High Holborn
London WC1V 7LE (GB)

(54) Method and apparatus for editing or mixing compressed pictures.

(57) In editing first and second compressed picture data each having been obtained by prediction-coding, the second compressed picture data is modified by decoding a frame of the second compressed picture data at an editing point and re-coding the decoded data so that every frame around the editing point can be decoded after editing. The first compressed picture data and the modified second compressed picture data are liked to complete the editing. In mixing a compressed picture data with a non-compressed picture data, the compressed picture data is decoded and added to the non-compressed picture data to obtain a mixed picture data. The mixed picture data is re-coded to be a compressed picture data. In each of the editing and mixing, the re-coding may be performed by using at least one of the motion compensation information, motion vector information and orthogonal transform mode information which can be derived from the compressed picture data in the decoding process.

Fig. 1



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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a compressed picture editing method for editing compressed picture data, and a picture coding apparatus for mixing a part or whole of compressed picture data with other compressed picture data or real time picture data.

2. Description of the Prior Art

A digital video signal possesses an enormous amount of information, and picture coding is indispensable for transmission and recording. Various picture coding techniques have been developed recently, and some of them are produced as encoders and decoders.

As an example, a conventional picture coding apparatus using the MPEG (moving picture coding experts group) method is described below while referring to accompanying drawings.

Fig. 15 is a block diagram of the conventional picture coding apparatus. The apparatus comprises a motion detector 81, a DCT (discrete cosine transform) mode judging circuit 82, a DCT circuit 83, a quantizing circuit 84, a variable length coding circuit 85, an inverse quantizing circuit 86, an inverse DCT circuit 87, a frame memory 88, and a motion compensation circuit 89. Fig. 16 is an explanatory diagram of motion compensation predicting method, and Fig. 17 is an explanatory diagram of the frame memory 88 and the motion compensation circuit 89.

In thus constituted conventional picture coding apparatus, a video signal is scanned by interlacing, and is entered as being divided into frame units. A picture in a first frame to be coded, that is, frame t in Fig. 16 is processed by intraframe coding using the data within the frame. First, the DCT mode judging circuit 82 detects the motion of the input picture data in each two-dimensional block of pixels by, for example, calculating inter-line differences, determines from the detection result whether to perform DCT in frame unit or in field unit, and outputs the determination result as DCT mode information. The DCT circuit 83 receives the DCT mode information, and performs the DCT in either frame unit or field unit to transform the picture data into transform coefficients. The transform coefficients are quantized in the quantizing circuit 84, and variable-length coded in the variable length coding circuit 85 to obtain a coded bit stream which is sent out to a transmission line. The quantized transform coefficients are simultaneously fed into the inverse quantizing circuit 86 and the inverse DCT circuit 87 to be returned to real time data, and stored in the frame memory 88.

Generally, pictures are high in degree of correlation, and DCT causes to concentrate the energy on the transform coefficients corresponding to low frequency components. Therefore, by quantizing roughly the high frequency components which are less obvious visually and finely the low frequency components which are important components, the picture quality deterioration is kept to a minimum, and the data quantity can be decreased at the same time. In the interlace scanned picture, if the motion is small, the intraframe correlation is strong, and if the motion is large, the interframe correlation is small while the intra-field correlation is high. By making use of such characteristics of interlace scanning, i.e., by changing over the frame-based DCT and the field-based DCT, the interlaced picture can be coded efficiently.

On the other hand, in the pictures after frame t+1, predicted picture values are calculated in every frame, and differences of the predicted picture values from the original picture values, i.e., the predicted errors are coded.

In MPEG, the calculating method of the predicted picture value includes forward prediction, backward prediction, and bidirectional prediction. Fig. 16 is an explanatory diagram of the prediction methods. The frame at time t is intraframe coded (hereinafter, an intraframe coded frame is called I frame). Then, a difference of the frame at time t+3 from a frame obtained by decoding the I frame is calculated after motion compensation, and this difference is coded. This operation for predicting a frame which is ahead in time is called forward prediction (hereinafter, a frame coded by forward prediction is called P frame). Frames at time t+1, t+2 are similarly subjected to motion compensation, difference calculation and difference coding by using frames decoded from the I and P frames. At this time, the predicted picture is composed by selecting in a block having a minimum error from the blocks of I frame (forward prediction), P frame (backward prediction), and the mean of I frame and P frame (bidirectional prediction) (hereinafter, a frame coded at a part or whole thereof by bidirectional prediction is called B frame). The B frame is predicted from frames before and after in time, so that a newly appearing object can be predicted accurately, thereby enhancing the coding efficiency.

As the encoder, in the first place, the motion vector to be used in prediction is detected in the motion detector 81 on a two-dimensional block by block basis by, for example, the well-known full search method. Next, using the detected motion vector, the frame memory 88 and the motion compensation circuit 89 generate a next predicted value compensated for the motion in each two-dimensional block.

Fig. 17 is an example of constitution of the motion compensation circuit 89. Herein is explained generation of predicted value of bidirectional prediction. The motion vector calculated in the motion detector 81 is fed into an address circuit 882 in the frame memory 88, and pictures of I and P frames stored in the frame

memory 881 are read out. At this time, to correspond to the interlaced picture same as in DCT, the two-dimensional blocks are formed in each frame or each field, and the vectors and predicted picture values are generated respectively. In each two-dimensional block, as prediction errors, forward prediction error, bidirectional prediction error and backward prediction error by using frame vectors, and forward prediction error, bidirectional prediction error and backward prediction error by using field vectors, that is, six kinds of errors in total are calculated in square error calculating circuits 893 to 898. A smallest one of the six errors is selected in an error comparator 899, and the predicted values and prediction mode information are issued. The above prediction mode information, motion vector, and DCT mode information are variable-length coded in the variable length coding circuit 85, and sent out to the transmission line together with the DCT transform coefficients.

Thus, according to such a picture coding apparatus, since the predicted error is optimally coded, the energy is decreased and coding of higher efficiency is realized as compared with the case of direct coding of picture data such as intraframe coding. (Refer, for example, ISO/IEC JTC1/SC29/WG11 N0502, "Generic Coding of Moving Pictures and Associated Audio," July 1993.)

However, when editing the compressed picture data coded in such picture coding method, various problems occur because the differences of picture data are coded. Fig. 18 is an explanatory diagram showing a conventional editing method of compressed picture data. Referring now to Fig. 18, the problems are explained below. In Fig. 18, suppose to link compressed picture data of (a) and (b) at the dotted line portions. Numerals given in Fig. 18 represent frame numbers. Since the B frame is coded after the I and P frames have been coded, the sequence of the coded frames is changed from the sequence to be displayed. After linking the compressed picture data of (a) and (b), the P and B frames right after the editing point, that is, the P frame of frame number 8 and the B frames of frame numbers 6 and 7 in the compressed picture data (b) cannot be decoded because the I frame of frame number 5 used in prediction is lost. Also, the pictures after frame 9 used in prediction of the P frame of frame number 11 cannot be decoded.

Moreover, various problems occur when the compressed picture data coded by the picture coding method with other picture data. The conventional picture mixing of analog signals is realized by adding elements together, but the compressed picture data are coded in variable length, and cannot be added simply on a bit by bit basis. Besides, in order to perform mixing by decoding the compressed picture to restore real time picture data, adding the decoded picture to other picture and coding the added result again, the mixing apparatus must be provided with both a decoder and an encoder, which results in a large size.

SUMMARY OF THE INVENTION

It is hence a primary object of the invention to present an editing and mixing methods of compressed pictures, and an editing and mixing apparatuses of compressed pictures, capable of editing and mixing compressed pictures compression-coded by the interframe difference coding in a simple constitution.

To achieve the object, the invention presents a compressed picture editing method comprising the steps of: receiving first and second compressed picture data each having been obtained by prediction-coding by at least one type of prediction out of a forward prediction for predicting a picture data in a current frame from a previous frame ahead in time, a backward prediction for predicting from a subsequent frame behind in time, and a bidirectional prediction simultaneously using both the forward prediction and the backward prediction; decoding the second compressed picture data; intraframe coding a frame of the decoded picture corresponding to a editing point; prediction-coding again a part or whole of the other frames of the decoded picture by using motion compensation, motion vector, and orthogonal transform mode information obtained by decoding the second compressed picture data to obtain modified second compressed picture data; and linking the first compressed picture data with the modified second compressed picture data.

In this constitution, the compressed picture data is once decoded, and the frame right after the editing point is coded again into an I frame, so that the predicted picture will not be lost by editing. For coding P and B frames, the motion compensation, motion vector and DCT mode information obtained by decoding are used, so that a motion detector and a DCT mode judging circuit required for mass calculation in the conventional picture encoder are not necessary, and the motion compensation circuit is simplified. Accordingly, the compressed picture data can be edited in a simple constitution.

In a compressed picture mixing method of the invention, a first compressed picture data is decoded, the decoded picture data and a second picture data are added to create a mixed picture data, and the mixed picture data is prediction-coded again by using motion compensation information, motion vector, and orthogonal transform mode information obtained by decoding the first compressed picture data.

In another method, a first compressed picture data and a second compressed picture data having been compression-coded in the same manner as in the first compressed picture data are decoded, orthogonal transform coefficients of the first compressed

picture data and the second compressed picture data are added to create a mixed picture data, and the mixed picture data is prediction-coded again by using motion compensation information, motion vector, and orthogonal transform mode information obtained by decoding the first compressed picture data.

According to this constitution, since the real time picture data or orthogonal transform coefficients are added after decoding the compressed picture data, even compressed picture data coded by variable length coding can be mixed. In addition, when coding the mixed picture again, since the motion compensation, motion vector, and orthogonal transform mode information obtained by decoding are used, a motion detector and an orthogonal transform mode judging circuit required for mass calculation in the conventional picture encoder are not necessary, and the motion compensation circuit is simplified. Accordingly, the compressed picture data can be mixed in a simple constitution. Furthermore, the picture data to be mixed may be multiplexed on the compressed picture data in transmission, so that a picture mixing apparatus light in the load at the coding side can be realized.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a compressed picture encoder in a first embodiment of the invention.

Fig. 2 is a constitution diagram of a simplified motion compensation circuit and a frame memory in the first embodiment of the invention.

Fig. 3 is an explanatory diagram of algorithm showing an example of operation of CPU in the first embodiment of the invention.

Fig. 4 is an explanatory diagram showing an editing method of compressed picture data in the first embodiment of the invention.

Fig. 5 is an explanatory diagram showing an editing method of compressed picture data in a second embodiment of the invention.

Fig. 6 is an explanatory diagram showing an editing method of compressed picture data in a third embodiment of the invention.

Fig. 7 is an explanatory diagram showing an editing method of compressed picture data in the third embodiment of the invention.

Fig. 8 is a block diagram of a picture mixing apparatus in a fourth embodiment of the invention.

Fig. 9 is an explanatory diagram of algorithm showing an example of operation of CPU in the fourth embodiment of the invention.

Fig. 10 is an explanatory diagram showing a motion compensation method of mixed picture in the fourth embodiment of the invention.

Fig. 11 is a block diagram of a picture mixing apparatus in a fifth embodiment of the invention.

Fig. 12 is an explanatory diagram of a compressed picture mixing method in a sixth embodiment of the invention.

Fig. 13 is an explanatory diagram of a compressed picture mixing apparatus in the sixth embodiment of the invention.

Fig. 14 is a block diagram of the picture mixing apparatus in the sixth embodiment of the invention.

Fig. 15 is a block diagram of a conventional picture encoder.

Fig. 16 is an explanatory diagram of a conventional motion compensation prediction method.

Fig. 17 is a constitution diagram of conventional motion compensation circuit and frame memory.

Fig. 18 is an explanatory diagram showing a conventional editing method of compressed picture data.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A compressed picture editing method according to a first embodiment of the invention is described below while referring to the drawings.

Fig. 1 is a block diagram of a picture encoder in the first embodiment of the invention. In Fig. 1, reference numeral 1 denotes a picture decoding unit which comprises a variable length decoding circuit 11, an inverse quantizing circuit 12, an inverse DCT circuit 13, a frame memory 14, and a simplified motion compensation circuit 15. Reference numeral 2 is a picture encoding unit which comprises a DCT circuit 21, a quantizing circuit 22, a variable length coding circuit 23, an inverse quantizing circuit 24, an inverse DCT circuit 25, a frame memory 26, and a simplified motion compensation circuit 27. Reference numeral 3 is a control unit which comprises a CPU. Fig. 2 is a detailed structural diagram of the simplified motion compensation circuit 15 and frame memory 14, Fig. 3 is an explanatory diagram of algorithm showing an example of operation of the CPU 3, and Fig. 4 is an explanatory diagram showing an editing method of compressed picture data. The frame accompanied by an apostrophe (') denotes a re-coded frame. It is the same in Figs. 5 through 7.

Thus constituted picture encoder is described while referring to Figs. 1 through 4.

Suppose to link compressed picture data (a) and (b) in Fig. 4. For the sake of simplicity, the editing point is supposed to be a P frame. When the compressed picture data (a) in Fig. 4 enters the picture encoder in Fig. 1, it is put out as it is until coming to the editing point indicated by the dotted line in Fig. 4. On the other hand, the compressed picture data (b) in Fig. 4 is put in the picture decoding unit 1, but the output of the picture coding unit 2 is not sent outside up to the editing point. The compressed picture data (b) is decoded in the picture decoding unit 1. That is, depending on the DCT mode information that is decoded in variable length in the variable length decoding circuit 11, inversely quantized in the inverse quan-

tizing circuit 12, and decoded in the inverse DCT circuit 13, inverse DCT is performed on a frame by frame or field by field basis to return to real time picture data. Yet, because of the difference coding, using the decoded motion vector and motion compensation mode information, a predicted picture is generated in the frame memory 14 and simplified motion compensation circuit 15, and is summed with the inverse DCT circuit output data, thereby creating decoded picture data. Fig. 2 is a constitutional example of the frame memory 14 and simplified motion compensation circuit 15. As compared with the conventional picture encoder, the constitution of the frame memory 14 is the same, but the motion compensation circuit 15 is substantially different. Since the motion compensation mode has been already determined by the encoder, any square error calculation circuit is not needed in the picture decoding unit, and hence it only requires, as shown in Fig. 2, a mean calculating circuit 151 necessary when the bidirectional prediction is selected, and a selector 152 for issuing a predicted picture depending on the motion compensation mode information.

When a signal showing an editing point is entered, as shown in (c), the P frame right after the editing point, among the compressed picture data (b), is re-coded as an I frame, and is linked to the compressed picture data (a) and issued. In the compressed picture data (b), the B frames of frame numbers 6, 7 are coded again by backward prediction because the I frame of frame number 5 necessary for forward prediction has been lost by editing. As for the P frame after frame number 8 in the compressed picture data (b), since the picture used in prediction has been coded again, the predicted picture is set again to a correct one, and the P frame is coded again into a new P frame, and the B frame B into a new B frame. The re-coding method is nearly the same as in the prior art, except that the motion compensation mode information, motion vector, and DCT changeover information are obtained by decoding the compressed picture data (b). Therefore, the picture coding unit 2 does not require a motion detection circuit and a DCT mode judging circuit for mass calculation as used in the conventional picture encoder in Fig. 14, and the motion compensation circuit 89 can be replaced by the simplified motion compensation circuit 27 same as the one in the decoding apparatus. All of the control is effected by the CPU 3, and its algorithm is shown in Fig. 3.

Fig. 3 shows a flow chart of the main routine showing the entire operation, sub-routine for coding the P frame right after the editing point used in the main routine into an I frame, sub-routine for coding the B frame into a P frame by using backward prediction only, sub-routine for re-coding the P frame and B frame, and intraframe coded block coding sub-routine and backward prediction block coding sub-routine for coding by changing the motion compensation mode of block of each frame being used in the foregoing sub-routines.

In a general decoder, a reception buffer of a specific capacity is provided, and deviation of transmission rate and decoding speed of the decoder is absorbed. In the encoder, compression and coding are effected while controlling so that the reception buffer of the decoder may cause neither overflow nor underflow. Similar operation is needed when editing compressed picture data. In this embodiment, for example, the CPU 3 sequentially calculates the buffer content in the reception buffer, and the quantizing width of the quantizing circuit 22 is controlled if necessary so that the compressed picture data after editing may cause neither overflow nor underflow of the reception buffer. Besides, as a simpler method for preventing overflow at the editing point, it is also possible to add dummy data other than picture data (all zero, etc.) to the picture data.

Thus, according to the embodiment, since the compressed image data to be edited is re-coded in the picture encoder of a simple constitution, even the compressed picture data using interframe difference coding can be edited without losing the compressed picture data after splicing.

Fig. 5 is an explanatory diagram of an editing method of picture compressed data in a second embodiment of the invention. The picture compressed data of (b) in Fig. 5 contains an I frame after the editing point. From the editing point to the point before the frame number 11, the frames are re-coded in the same manner as in the first embodiment. Since the I frame of frame number 11 has been coded within the frame, it is not affected by editing. Therefore, the I frame is not re-coded. As for the B frames of frame numbers 9, 10, since the P frame of frame number 8 is coded newly into an I frame, the B frames 9, 10 are re-coded by using the newly coded I frame. As for the frames after frame number 14, since the I frame of frame number 11 is not re-coded, there is no effect and it is not necessary to re-code, and the compressed picture data is issued as it is. The operation so far can be realized by varying the program of the CPU 3 in the first embodiment.

According to the embodiment, thus, the number of frames to be re-coded may be decreased, and picture quality deterioration due to re-coding may be kept to a minimum limit.

In the second embodiment, frames after frame number 14 are not re-coded because the I frame of frame number 11 is not re-coded. However, as mentioned in the first embodiment, when control of reception buffer is necessary, not only the B frame right after the I frame, but also all P and B frames may be re-coded as shown in (d) of Fig. 5.

According to this technique, while keeping few the frames to be re-coded, compressed picture data

after editing free from problems of overflow or underflow of reception buffer may be obtained.

Fig. 6 and Fig. 7 are explanatory diagrams of editing method of picture compressed data in a third embodiment of the invention. In this embodiment, the editing point in (b) of Fig. 6 of the compressed picture data to be connected is in a B frame. When the editing point is selected in the B frame, the editing point and the B frame continuous to the editing point cannot be decoded because the I or P frame used in prediction is lost at the time of coding in the first and second embodiments. In this embodiment, as shown in (c) of Fig. 6 or (c) of Fig. 7, an I or P frame just before the editing point used in prediction is inserted by the number of undecodable B frames. When the frame just before the editing point used in prediction is an I frame, as shown in (c) of Fig. 6, this I frame just before the editing point is inserted as it is, basically. In the case of a P frame, it is re-coded into an I frame as shown in (c) of Fig. 7. If the reception buffer is a problem, same as in the second embodiment, even in the case of the I frame, it is possible to re-code to control the quantizing width so as not to cause overflow or underflow.

Thus, according to the embodiment, if the editing point of the compressed picture data to be connected is a B frame, the picture quality deterioration due to re-coding may be kept to a minimum, while editing is enabled.

In the foregoing embodiments, there are two B frames, but this is not limited and it may be applied to three or more or one B frame.

In the embodiments above, for the sake of simplicity, the intraframe coding block in motion compensation mode of each block is omitted in explanation, but generally intraframe coding block mode can be selected on a two-dimensional block by block basis in the frame. When changing a B frame into a P frame composed only of backward prediction, the motion compensation mode of forward prediction block or the like can be re-coded in the same motion compensation mode as the motion vector is not contained in the compressed picture data. In such a case, it can be re-coded by selecting an intraframe coding block.

A compressed picture mixing method and a compressed picture mixing apparatus in a fourth embodiment of the invention are described below while referring to the accompanying drawings.

Fig. 8 is a block diagram of a picture mixing apparatus in the fourth embodiment of the invention. In Fig. 8, reference numeral 1 denotes a picture decoding unit, and 2 is a picture coding unit, and they operate in the same way as in the first embodiment. Fig.9 is an explanatory diagram of algorithm showing an example of operation of CPU 3, and Fig. 10 is an explanatory diagram showing the motion compensation method of mixed picture.

Thus constituted picture encoder is described below by reference to Figs. 8 through 10.

Suppose to mix a picture data with a compressed picture data that has been prediction-coded. The compressed picture data in Fig. 8 is entered from an input terminal 16, while a certain picture data is fed from an input terminal 41. The compressed picture data is decoded in the picture decoding unit 1 in the same way as in the first embodiment.

On the other hand, from the picture data to be mixed, picture information is detected in a picture information detector 4. The picture data to be mixed may be either an uncompressed picture data or another compressed picture data. The picture information detector 4 is a circuit for detecting the picture information to be used in coding a mixed picture. It may be omitted if it is not necessary to enhance the coding efficiency. The picture information to be detected may include, in the case of uncompressed picture data, motion information showing how may pixels in the picture are moving between frames. In the compressed picture data, the picture information detector may be composed in the same way as the picture decoding circuit 1, and the information to be detected may include motion vector, motion compensation information, and orthogonal transform mode information.

Mixing is achieved by adding the picture data decoded by the picture decoding unit 1 and the picture data output-ted from the picture information detector 4. In principle, mixing can be started from any frame, but it is desired to start from an intraframe coded frame (I frame). The reason is that, if started from a predicted frame, a completely new picture appears as if the scene were changed, which cannot be predicted from the preceding frame, thereby lowering the coding efficiency. Besides, depending on the picture to be mixed, the content is not changed frequently such as the superimposed dialogue. In such a case, by changing the content at intervals of the intraframe coding frames, the interframe difference can be decreased, so that the coding efficiency can be enhanced.

The mixed picture data after addition is re-coded in the picture coding unit 2 into compressed picture data. Fig. 10 shows the motion compensation method of blocks in each frame. The solid line in Fig. 10 denotes decoded picture data, and picture data of broken line, or block b, is the added mixed picture data. Frame t+3 uses frame t as prediction picture. The decoded motion vectors of the respective blocks are indicated by arrows mva, mvb, mvc in the diagram.

In block a, decoded picture data is used as prediction picture. The re-coding method of block a is nearly the same as the coding method in the prior art, but the motion compensation mode information, motion vector, and DCT change-over information are information obtained by decoding the compressed picture data. Therefore, in the picture coding unit 2, a motion detector and a DCT mode judging circuit re-

quiring massive calculation are eliminated differently from the image encoder of the prior art shown in Fig. 16, and the motion compensation circuit 89 may be replaced with a simplified motion compensation circuit 27 which is the same as the one in the decoding apparatus.

Block b is replaced with mixed picture data in frame t+3. Therefore, the content is completely different from the predicted image generated in the motion vector mvb. Therefore, by intraframe coding the block b, or replacing mvb with mvb', the motion compensation information and motion vector are changed so as to predict from the mixed block. Herein, mvb' is the motion information of the picture data to be mixed as being detected in the picture information detector 4.

Block c is predicted by motion vector mvc, but the predicted picture of frame t is replaced by mixing, and therefore the predicted picture is completely different. In block c, hence, by replacing the intraframe coding block or mvc with mvc', the motion compensation and motion vector are changed so as to predict from the decoded picture data.

It is the CPU 3 that is responsible for these controls, and Fig. 9 shows an algorithm of an example of operation of the CPU 3. In Fig. 9, of the operation described above, the case of changing the block lost of predicted picture into an intraframe coding block is sequentially shown in flow chart.

On the above embodiment, the compressed picture data is decoded and added to another picture data, and the mixed picture data is re-coded by using the motion compensation information or the like obtained by decoding the compressed picture data, so that the compressed mixed picture data can be obtained in a simple constitution.

Moreover, the predicted picture lost by mixing is replaced by a new predicted picture obtained by intraframe coding or vector correction, and the picture in the region is predicted by using the motion information of the mixed picture, so that mismatching with the predicted picture does not occur, and efficient coding is effected without causing picture deterioration.

In the foregoing embodiments, the picture is mixed on a block by block basis, but this is not limitative, and mixing over plural blocks is also possible. In such a case, to change the motion compensation information, the motion compensation information of decoded picture data or motion information of picture data to be mixed may be selectively used depending on the rate of mixed data contained in the block.

In the above embodiments, as the picture coding unit and picture decoding unit, the interframe difference and DCT are combined, but this is not limitative, and any other method may be employed as far as the motion compensation and interframe difference are employed.

Fig. 11 is a block diagram of a compressed picture mixing apparatus in a fifth embodiment of the invention. What differs from the fourth embodiment is that orthogonal transform coefficients are added as the manner of adding the picture data. That is, instead of directly adding the pixels, the pixels are converted into coefficients by orthogonal transform, and the transform coefficients are added. Since, the picture data to be added are transform coefficients, a transform circuit 42 is provided in the picture information detector 4 in Fig. 11. The transform circuit may be, simply, only a DCT circuit for transforming the pixel data into transform coefficients. Alternatively, using the same coding circuit as in the prior art, the transform coefficients after DCT transform may be issued.

In this embodiment, too, the same effect as in the fourth embodiment may be obtained.

Fig. 12 is an explanatory diagram of compressed picture mixing method in a sixth embodiment of the invention. In this embodiment, as shown in Fig. 12, compressed picture data A and compressed picture data B to be mixed with the compressed picture data A are multiplexed by giving different identifiers. Fig. 13 shows an example of a circuit for generating the multiplexed compressed picture data shown in Fig. 12. In Fig. 13, the compressed picture data A is stored in a first buffer 131, and the compressed picture data B is stored in a second buffer 132. A multiplexer 134 adds the identifier generated in an identifier generating circuit 132 before each compressed picture data while adjusting the timing, and multiplexes and delivers the data in the sequence in Fig. 12.

Fig. 14 is a block diagram of a picture mixing apparatus for decoding and mixing the multiplexed compressed picture data. The multiplexed compressed picture data are separated depending on the identifier by a de-multiplex circuit 5, and fed into different picture decoding units 1. Each picture decoding unit 1 is the same as the picture decoding unit 1 in Fig. 11. The picture data obtained by decoding in the picture decoding units are added by an adder 140 to generate a mixed picture data.

In this way, by multiplexing two or more compressed picture data to be mixed, separating them at the decoding side, and adding the pixel data thereof, a mixed picture is obtained. In this embodiment, plural picture decoding units 1 are necessary, but, for example, in the case of simultaneous broadcasting of multiple programs, when it is desired to mix same character information in each, the mixing devices are needed as many as the number of programs at the transmission side in embodiments 4 and 5, but only one is enough at the transmission side in this embodiment. Or, by selecting the identifier at the reception side, it is also possible to select the picture to be mixed.

The sixth embodiment is an example of compressed picture data being compressed by prediction and coding, but this is not limitative, and it can be also applied to compressed picture data using only intra-

frame coding.

Moreover in the sixth embodiment, having two picture decoding units, the pictures decoded by the respective picture decoding units are added, but depending on the method of mixing pictures, it is possible to replace a part of one picture with a part of other picture. In such a case, two picture decoding units are not needed, and by setting picture decoding in the same picture decoding unit at different times, a mixed picture may be obtained by a single picture decoding unit.

In the foregoing embodiments, nothing is mentioned about the resolution of the mixing picture and mixed picture, but these pictures may differ in resolution, and a small picture may be mixed in a part of a large picture, or only a partial region of a picture may be mixed if identical in resolution.

Claims

1. A compressed picture editing method for linking at an editing point first and second compressed picture data each having been obtained by prediction-coding employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said method comprising the steps of:

    receiving the first and second compressed picture data;

    decoding a frame of the second compressed picture data at a position corresponding to the editing point to generate a decoded frame;

    intraframe coding the decoded frame to generate a modified second compressed picture data having an intraframe coded frame at the position corresponding to the editing point; and

    linking the first compressed picture data and the modified second compressed picture data at the editing point.

2. A method according to claim 1, wherein said decoding step produces motion compensation information of the decoded frame, and wherein said method further comprising the steps of decoding at least a part of the remaining frames of the second compressed picture data to obtain decoded frames, and prediction-coding the decoded frames by using the motion compensation information.

3. A method according to claim 1, wherein said decoding step produces motion vector information of the decoded frame, and wherein said method further comprises the steps of decoding at least a part of the remaining frames of the second compressed picture data to obtain decoded frames, and prediction-coding the decoded frames by using the motion vector information.

4. A method according to claim 1, wherein said method further comprises the steps of decoding at least a part of the remaining frames of the second compressed picture data to obtain decoded frames, and prediction-coding the decoded frames so as to change a bidirectional prediction frame in the second compressed picture data to either a forward prediction frame or a backward prediction frame.

5. A method according to claim 1, wherein said method further comprises the steps of decoding at least a part of the remaining frames of the second compressed picture data to obtain decoded frames, and prediction-coding the decoded frames except for a part or all of intraframe coded frames in the second compressed picture data.

6. A method according to claim 1, wherein said method further comprises the steps of decoding at least a part of the remaining frames of the second compressed picture data to obtain decoded frames, and prediction-coding the decoded frames so as to change a part or all of a forward prediction frame, a backward prediction frame and a bidirectional prediction frame in the second compressed picture data to an intraframe coded frame.

7. A method according to claim 1, wherein said method further comprises the steps of decoding at least a part of the remaining frames of the second compressed picture data to obtain decoded frames, and prediction-coding the decoded frames so as to change a bidirectional prediction frame in the second compressed picture data to an intraframe coded frame which corresponds to an intraframe coded frame which has been used for predicting the bidirectional frame.

8. A method according to claim 1, wherein said method further comprises the steps of decoding at least a part of the remaining frames of the second compressed picture data to obtain decoded frames, and prediction-coding the decoded frames so as to control the amount of coded data to prevent overflow and underflow of a buffer in a decoding apparatus.

9. A method according to claim 1, wherein said method further comprises the steps of decoding at least a part of the remaining frames of the second compressed picture data to obtain decoded

frames, prediction-coding the decoded frames to obtain re-coded frames, and adding a dummy data to the re-coded frames.

10. A compressed picture editing method for linking at an editing point first and second compressed picture data each having been obtained by dividing picture data in each frame into a plurality of two-dimensional blocks and coding each of the two-dimensional blocks by selectively using one of a frame-based orthogonal transform and a field-based orthogonal transform, said method comprising the steps of:

receiving the first and second compressed picture data;

decoding a frame of the second compressed picture data at a position around the editing point to generate a decoded frame and to obtain orthogonal transform mode information indicating whether each two-dimensional block in the decoded frame has been subjected to the frame-based orthogonal transform or the field-based orthogonal transform;

coding the decoded frame in accordance with the orthogonal transform mode information to obtain a re-coded frame and to generate a modified second compressed picture data containing the re-coded frame; and

linking the first compressed picture data and the modified second compressed picture data at the editing point.

11. A compressed picture editing apparatus for linking at an editing point first and second compressed picture data each having been obtained by prediction-coding employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said apparatus comprising:

means for receiving the first and second compressed picture data;

means for decoding a frame of the second compressed picture data at a position corresponding to the editing point to generate a decoded frame;

means for intraframe coding the decoded frame to generate a modified second compressed picture data having an intraframe coded frame at the position corresponding to the editing point; and

means for linking the first compressed picture data and the modified second compressed picture data at the editing point.

12. A compressed picture editing apparatus for linking at an editing point first and second compressed picture data each having been obtained by dividing picture data in each frame into a plurality of two-dimensional blocks, transforming each of the two-dimensional blocks by selectively using one of a frame-based orthogonal transform and a field-based orthogonal transform, and prediction-coding each transformed two-dimensional block by employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said apparatus comprising:

means for receiving the first and second compressed picture data;

decoding means for decoding a frame of the second compressed picture data at a position around the editing point to generate a decoded frame and to obtain motion compensation information and motion vector information of the decoded frame and orthogonal transform mode information indicating whether each two-dimensional block in the decoded frame has been subjected to the frame-based orthogonal transform or the field-based orthogonal transform;

encoding means for coding the decoded frame by using at least one of the motion compensation information, motion vector information and orthogonal transform mode information to obtain a re-coded frame and to generate a modified second compressed picture data containing the re-coded frame;

control means receiving the motion compensation information, motion vector information and orthogonal transform mode information for controlling the encoding means; and

means for linking the first compressed picture data and the modified second compressed picture data at the editing point.

13. A compressed picture mixing method for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by prediction-coding employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said method comprising the steps of:

receiving the first and second picture data;

decoding the first picture data to obtain a decoded first picture data and motion compensation information of the first picture data;

adding the decoded first picture data and

the second picture data to obtain a mixed picture data; and

coding the mixed picture data by using the motion compensation information.

14. A compressed picture mixing method for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by prediction-coding employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said method comprising the steps of:

receiving the first and second picture data;

decoding the first picture data to obtain first orthogonal transform coefficients of the first picture data and motion compensation information of the first picture data;

orthogonal transform coding the second picture data to obtain second orthogonal transform coefficients;

adding the first orthogonal transform coefficients and the second orthogonal transform coefficients to obtain mixed orthogonal transform coefficients;

coding the mixed orthogonal transform coefficients by using the motion compensation information.

15. A compressed picture mixing method for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by prediction-coding employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said method comprising the steps of:

receiving the first and second picture data;

decoding the first picture data to obtain a decoded first picture data;

adding at least a part of the decoded first picture data and the second picture data to obtain a mixed picture data which includes a first part containing only the decoded first picture data and a second part containing only the second picture data; and

coding the mixed picture data, said coding step coding said first part by prediction using only a picture data contained in the first picture data and coding said second part by prediction using only a picture data contained in the second picture data.

16. A compressed picture mixing method for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by prediction-coding employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said method comprising the steps of:

receiving the first and second picture data;

decoding the first picture data to obtain a decoded first picture data;

adding at least a part of the decoded first picture data and the second picture data to obtain a mixed picture data which includes a part containing the second picture data; and

coding the mixed picture data, said coding step including a step of motion compensating said part by using motion compensation information derived from one of the first picture data and the second picture data.

17. A compressed picture mixing method for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by dividing picture data in each frame into a plurality of two-dimensional blocks and coding each of the two-dimensional blocks by selectively using one of a frame-based orthogonal transform and a field-based orthogonal transform, said method comprising the steps of:

receiving the first and second compressed picture data;

decoding the first picture data to obtain a decoded first picture data and orthogonal transform mode information indicating whether each two-dimensional block in the decoded frame has been subjected to the frame-based orthogonal transform or the field-based orthogonal transform;

adding the decoded first picture data and the second picture data to obtain a mixed picture data; and

coding the mixed picture data by using the orthogonal transform mode information.

18. A compressed picture mixing method for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by prediction-coding employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and

backward prediction, said method comprising the steps of:

receiving the first and second picture data; and

adding the first picture data and the second picture data from a position where the first picture data contains an intraframe coded frame to obtain a mixed picture data.

19. A compressed picture mixing method for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by prediction-coding employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said method comprising the steps of:

receiving the first and second picture data; and

adding the first picture data and the second picture data to obtain a mixed picture data, said adding step including a step of changing the second picture data by using an intraframe coded frame contained in the first picture data.

20. A compressed picture mixing apparatus for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by dividing picture data in each frame into a plurality of two-dimensional blocks, transforming each of the two-dimensional blocks by selectively using one of a frame-based orthogonal transform and a field-based orthogonal transform, and prediction-coding each transform two-dimensional block by employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said apparatus comprising:

means for receiving the first and second picture data;

decoding means for decoding the first picture data to obtain a decoded first picture data and to obtain motion compensation information and motion vector information of the first picture data and orthogonal transform mode information indicating whether each two-dimensional block in each frame of the first picture data has been subjected to the frame-based orthogonal transform or the field-based orthogonal transform;

adding means for adding the decoded first picture data and the second picture data to obtain a mixed picture data;

encoding means for coding the mixed picture data by using at least one of the motion compensation information, motion vector information and orthogonal transform mode information; and

control means receiving the motion compensation information, motion vector information and orthogonal transform mode information for controlling the encoding means.

21. A compressed picture mixing apparatus for mixing a first picture data and a second picture data, the first picture data being a compressed picture data which has been obtained by dividing picture data in each frame into a plurality of two-dimensional blocks, transforming each of the two-dimensional blocks by selectively using one of a frame-based orthogonal transform and a field-based orthogonal transform, and prediction-coding each transformed two-dimensional block by employing at least one of a forward prediction for predicting a picture data in a frame from a preceding frame, a backward prediction for predicting from a succeeding frame and a bidirectional prediction using both the forward prediction and backward prediction, said apparatus comprising:

means for receiving the first and second picture data;

decoding means for decoding the first picture data to obtain first orthogonal transform coefficients and to obtain motion compensation information and motion vector information of the first picture data and orthogonal transform mode information indicating whether each two-dimensional block in each frame of the first picture data has been subjected to the frame-based orthogonal transform or the field-based orthogonal transform;

transform means for orthogonal transforming the second picture data to obtain second orthogonal transform coefficients;

adding means for adding the first orthogonal transform coefficients and the second orthogonal transform coefficients to obtain mixed orthogonal transform coefficients;

encoding means for coding the mixed orthogonal transform coefficients by using at least one of the motion compensation information, motion vector information and orthogonal transform mode information; and

control means receiving the motion compensation information, motion vector information and orthogonal transform mode information for controlling the encoding means.

22. A picture coding method comprising the steps of:

coding a first picture data to obtain a first compressed picture data;

coding a second picture data which is to be

mixed with the first picture data to obtain a second compressed picture data;

adding a first identifier indicating the first picture data to the first compressed picture data and adding a second identifier indicating the second picture data to the second compressed picture data:

multiplexing the first compressed picture data added with the first identifier and the second compressed picture data added with the second identifier.

23. A compressed picture data mixing-apparatus for mixing a first compressed picture data and a second compressed picture data which have been transmitted from an encoder in the form of a multiplexed data in which the first compressed picture data added with a first identifier and the second compressed picture data added with a second identifier different from the first identifier are multiplexed, said apparatus comprising:

means for receiving the multiplexed data;

means for extracting the first and second identifiers from the received multiplexed data and for extracting from the received multiplexed data the first compressed picture data and the second compressed picture data based on the extracted first and second identifiers;

decoding means for decoding the extracted first and second compressed picture data independently of each other to obtain first and second decoded picture data, respectively; and

adding the first decoded picture data and the second decoded picture data to obtain a mixed picture data.

Fig. 1

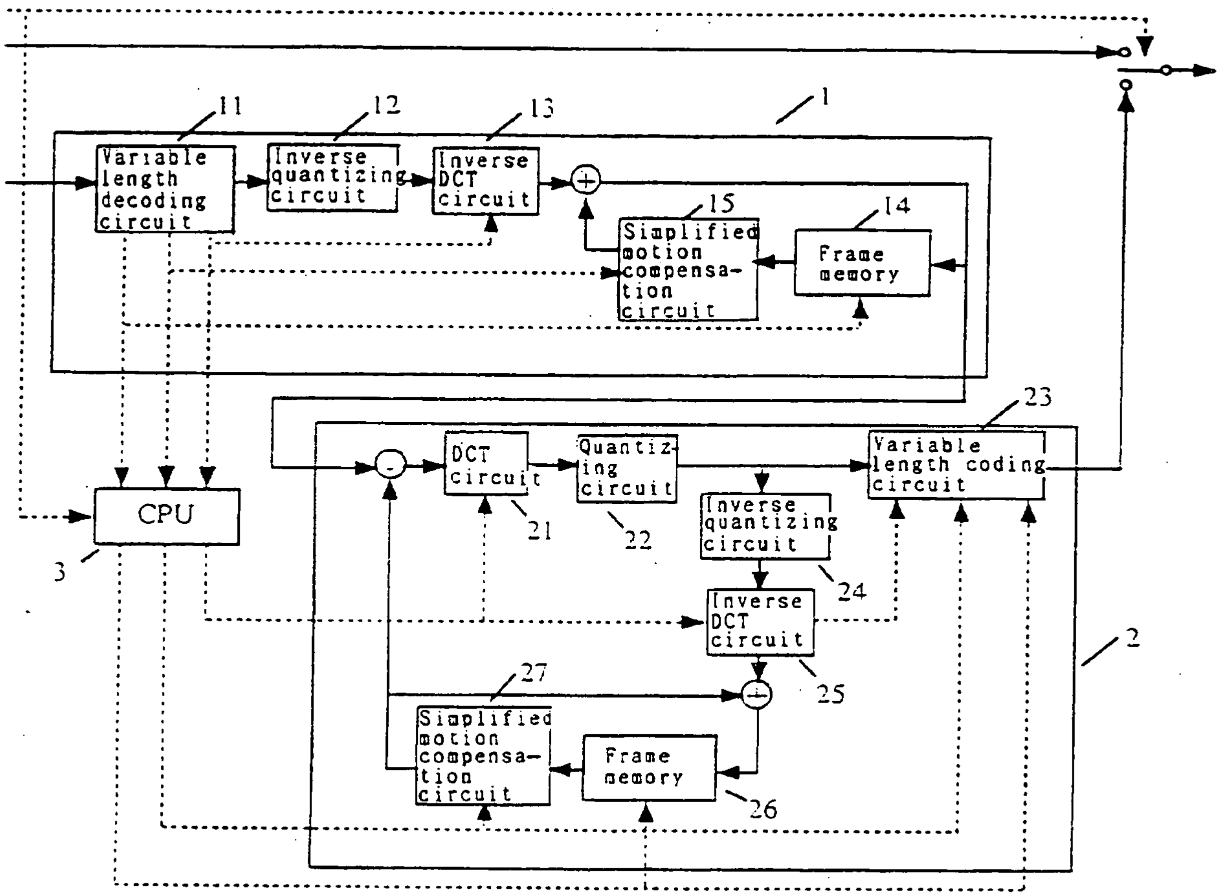

11
12
13
1
Variable length decoding circuit
Inverse quantizing circuit
Inverse DCT circuit
15
14
Simplified motion compensation circuit
Frame memory
23
DCT circuit
Quantizing circuit
Variable length coding circuit
CPU
3
21
22
Inverse quantizing circuit
24
Inverse DCT circuit
2
27
25
Simplified motion compensation circuit
Frame memory
26

Fig. 2

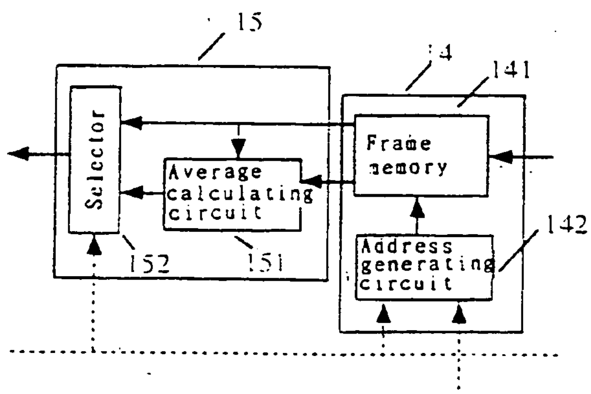

15
14
141
Selector
Average calculating circuit
Frame memory
142
Address generating circuit
152
151

Fig. 3

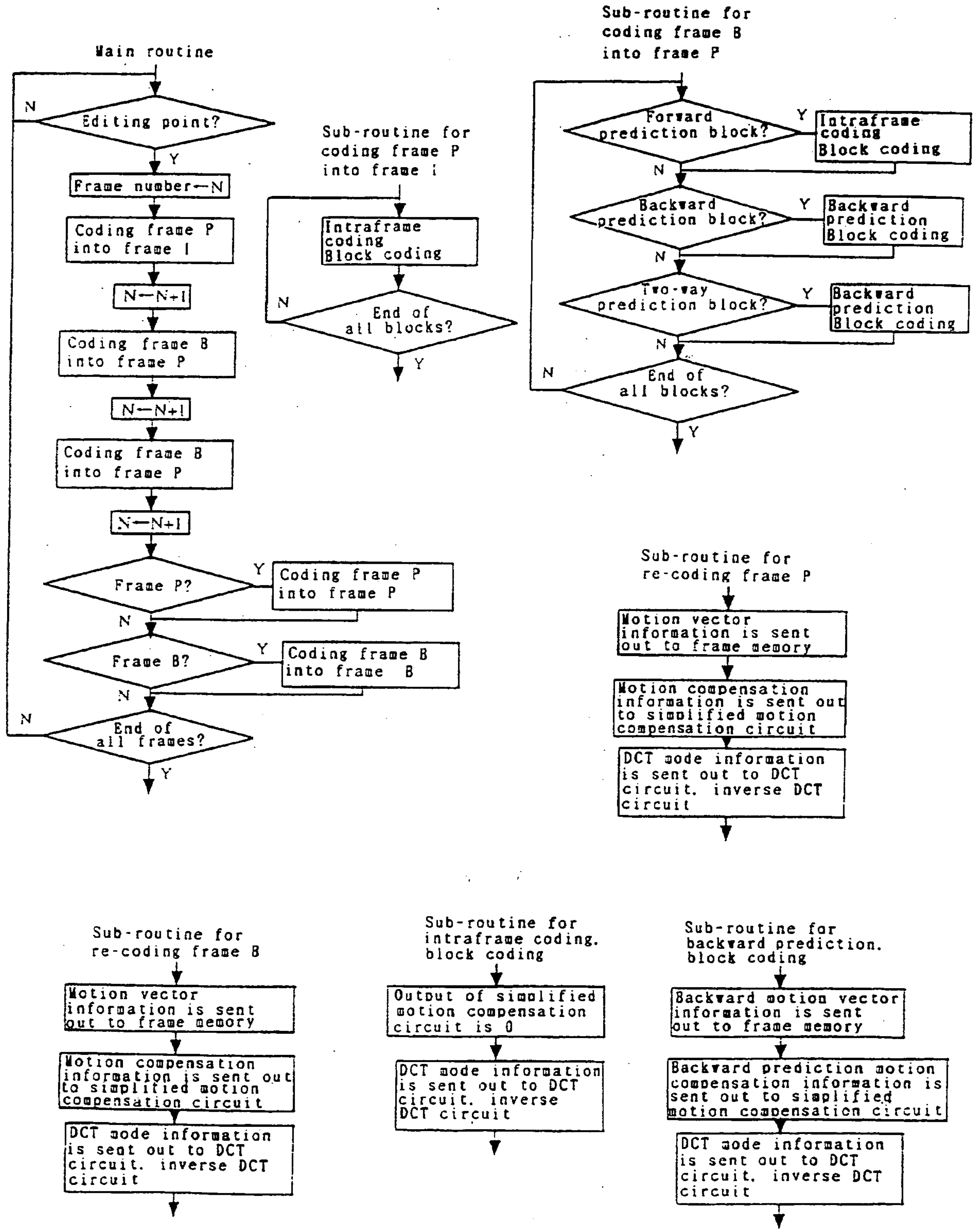

Main routine
Editing point?
N
Y
Frame number←N
Coding frame P into frame I
N←N+1
Coding frame B into frame P
N←N+1
Coding frame B into frame P
N←N+1
Frame P?
Y
Coding frame P into frame P
N
Frame B?
Y
Coding frame B into frame B
N
End of all frames?
N
Y
Sub-routine for coding frame P into frame I
Intraframe coding Block coding
End of all blocks?
N
Y
Sub-routine for coding frame B into frame P
Forward prediction block?
Y
Intraframe coding Block coding
N
Backward prediction block?
Y
Backward prediction Block coding
N
Two-way prediction block?
Y
Backward prediction Block coding
N
End of all blocks?
N
Y
Sub-routine for re-coding frame P
Motion vector information is sent out to frame memory
Motion compensation information is sent out to simplified motion compensation circuit
DCT mode information is sent out to DCT circuit. inverse DCT circuit
Sub-routine for re-coding frame B
Motion vector information is sent out to frame memory
Motion compensation information is sent out to simplified motion compensation circuit
DCT mode information is sent out to DCT circuit. inverse DCT circuit
Sub-routine for intraframe coding. block coding
Output of simplified motion compensation circuit is 0
DCT mode information is sent out to DCT circuit. inverse DCT circuit
Sub-routine for backward prediction. block coding
Backward motion vector information is sent out to frame memory
Backward prediction motion compensation information is sent out to simplified motion circuit
DCT mode information is sent out to DCT circuit. inverse DCT circuit

Fig. 4

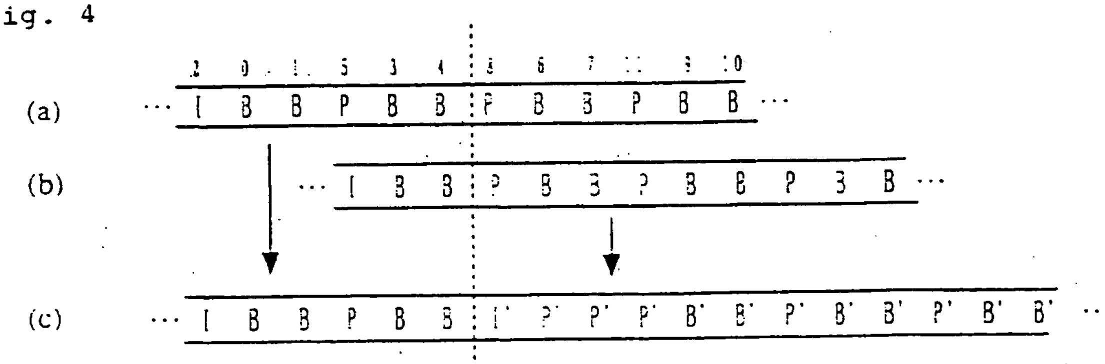


Fig. 5

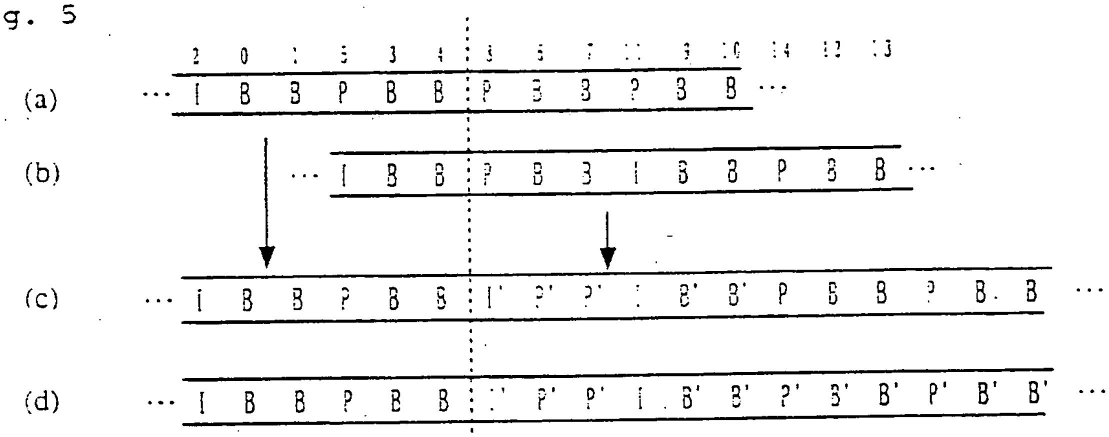


Fig. 6

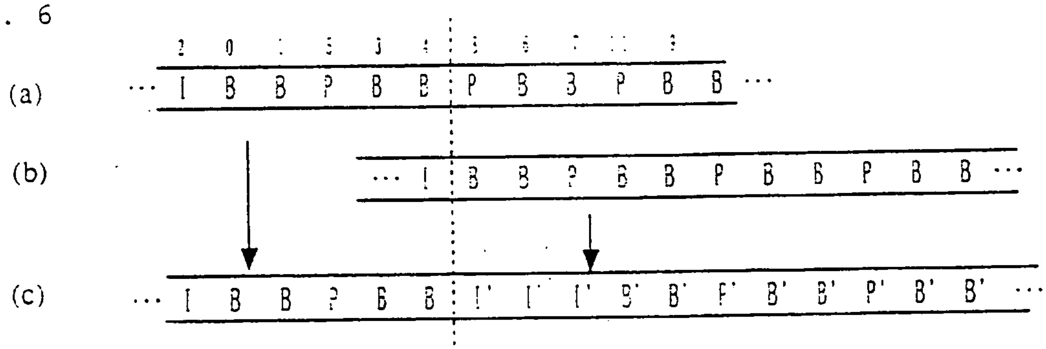


Fig. 7

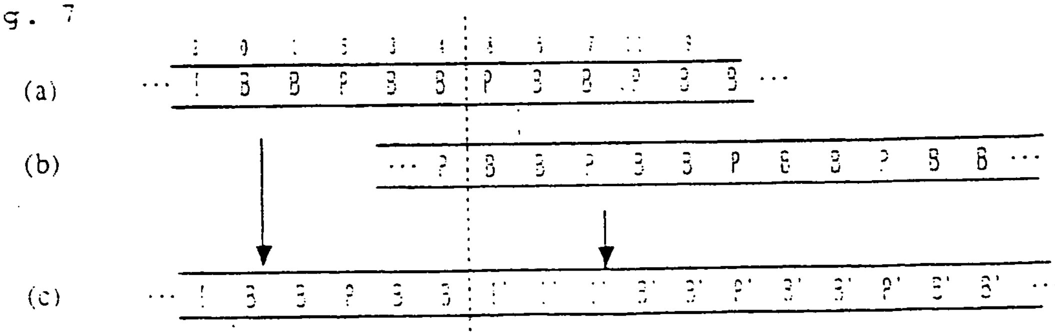


Fig. 8

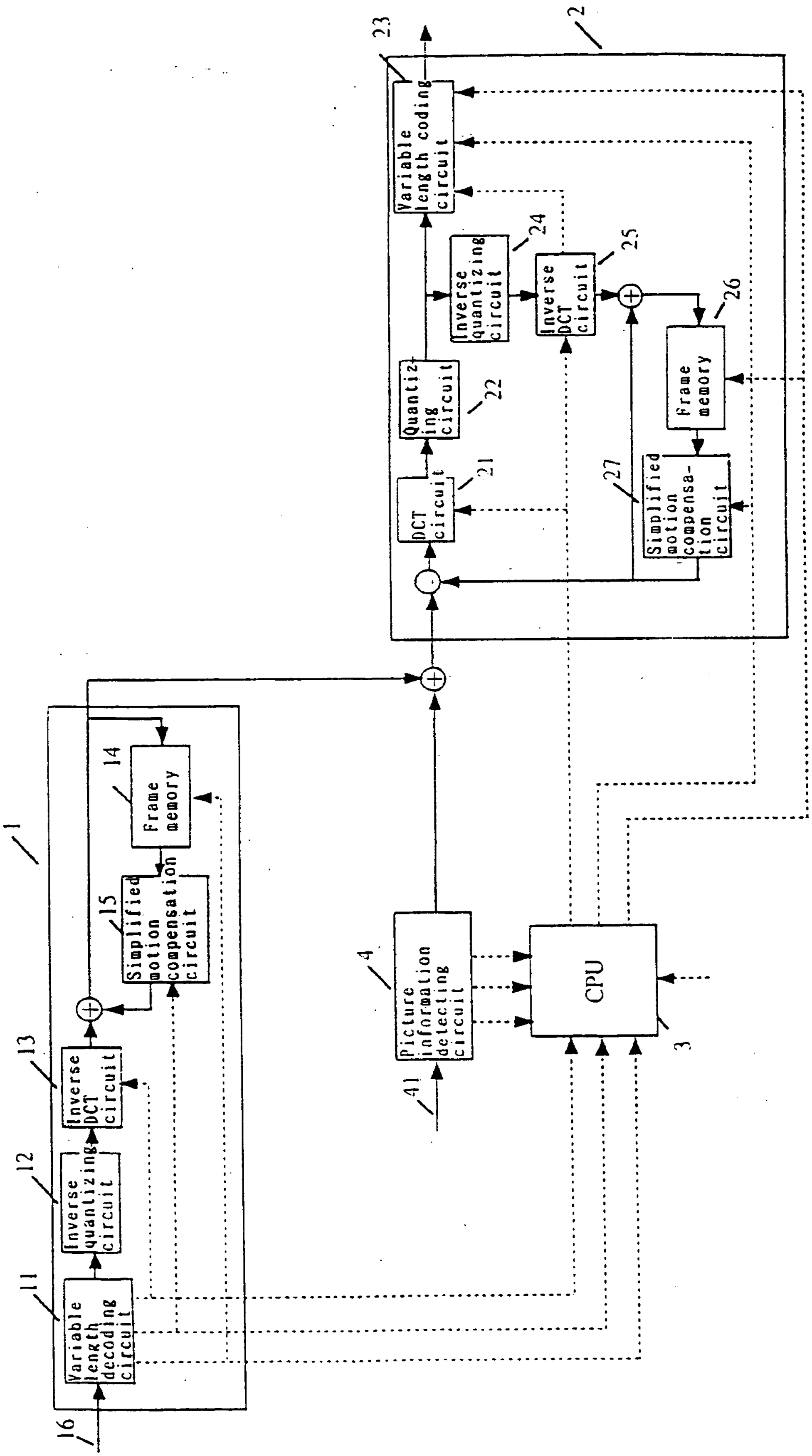
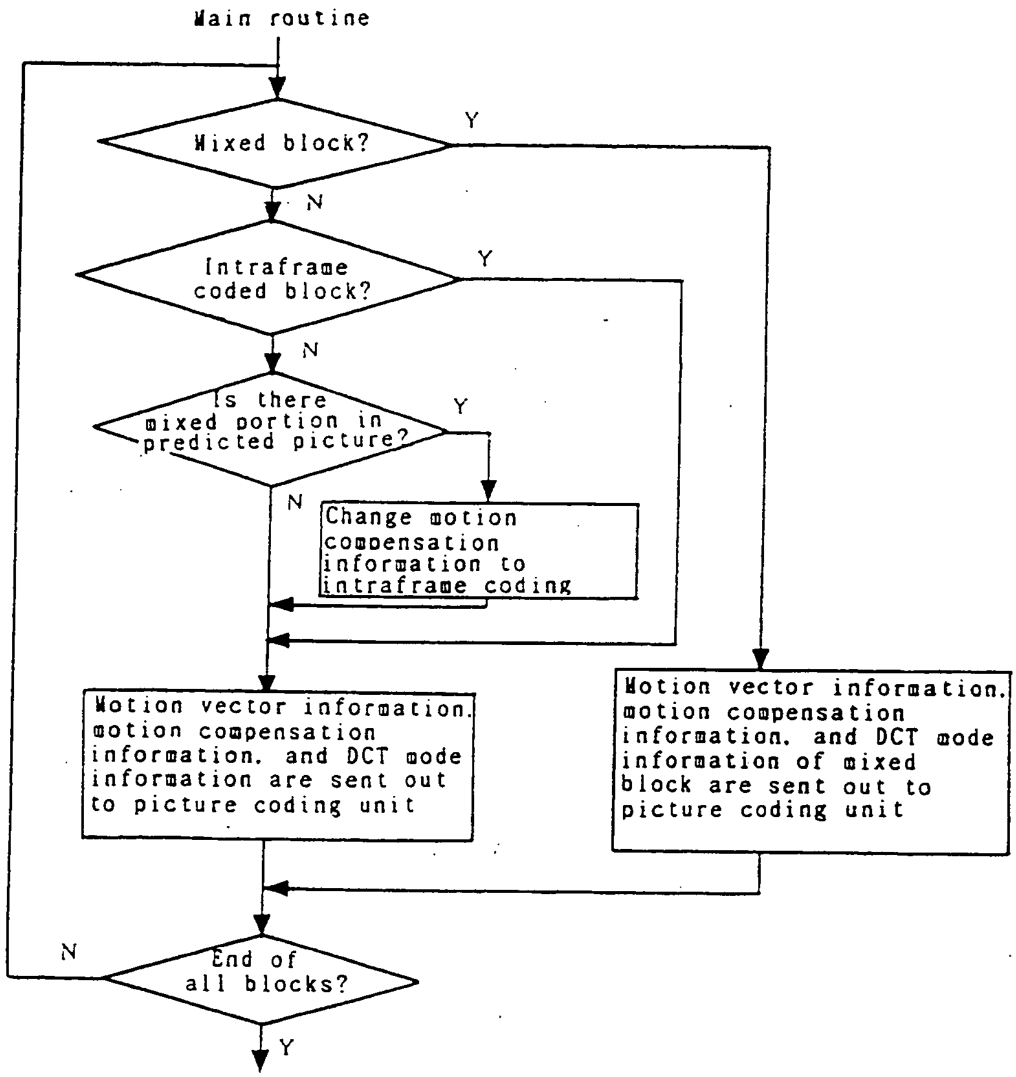

Variable length decoding circuit
Inverse quantizing circuit
Inverse DCT circuit
Frame memory
Simplified motion compensation circuit
Picture information detecting circuit
CPU
DCT circuit
Quantizing circuit
Variable length coding circuit
Inverse quantizing circuit
Inverse DCT circuit
Frame memory
Simplified motion compensation circuit
1
2
3
4
11
12
13
14
15
16
21
22
23
24
25
26
27
41

Fig. 9


Main routine
Mixed block?
Y
N
Intraframe coded block?
Y
N
Is there mixed portion in predicted picture?
Y
N
Change motion compensation information to intraframe coding
Motion vector information, motion compensation information, and DCT mode information are sent out to picture coding unit
Motion vector information, motion compensation information, and DCT mode information of mixed block are sent out to picture coding unit
N
End of all blocks?
Y

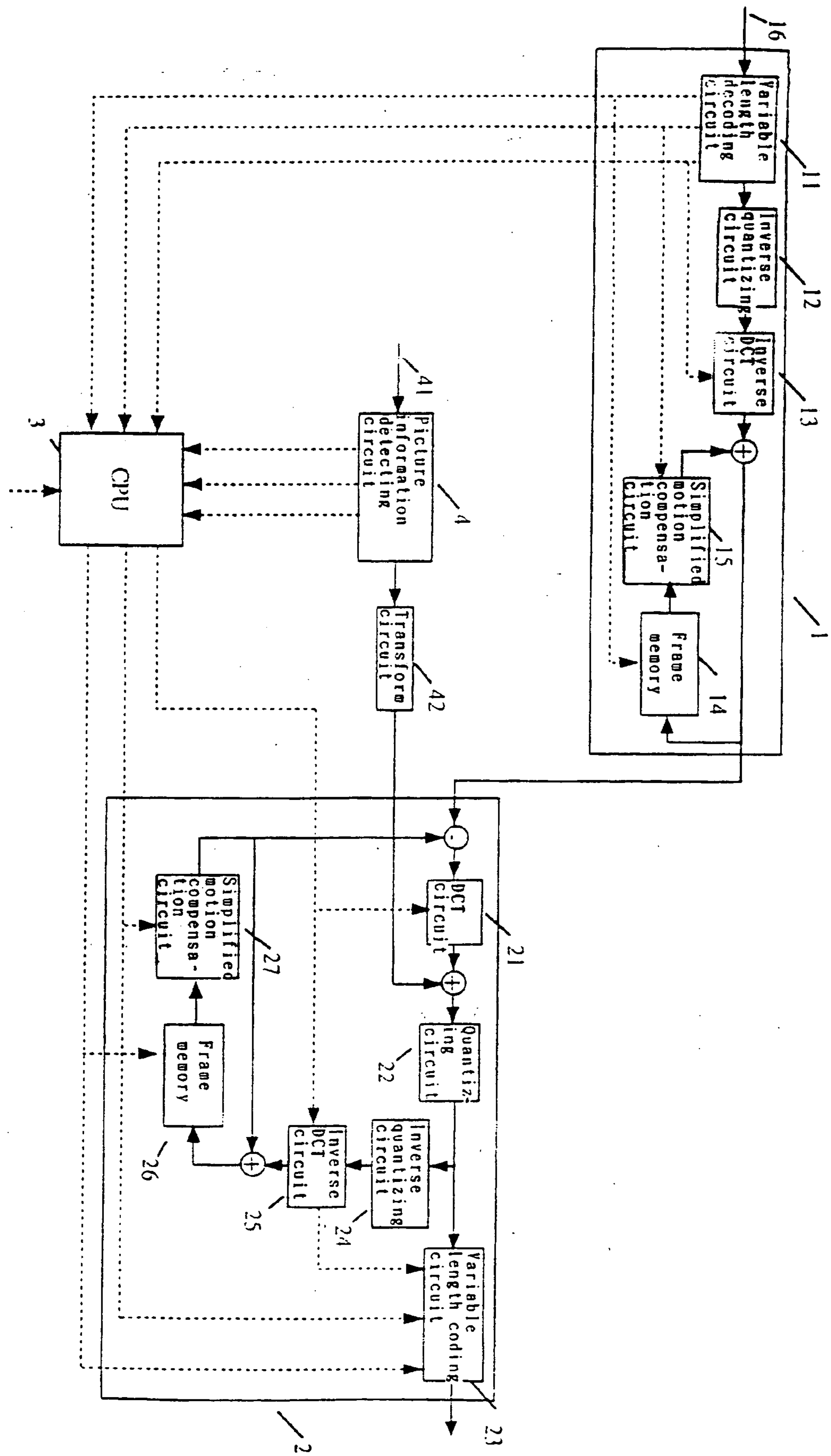

16
Variable length decoding circuit
11
Inverse quantizing circuit
12
Inverse DCT circuit
13
Simplified motion compensation circuit
15
Frame memory
14
1
41
Picture information detecting circuit
4
Transform circuit
42
3
CPU
DCT circuit
21
Quantizing circuit
22
Variable length coding circuit
23
Inverse quantizing circuit
24
Inverse DCT circuit
25
Frame memory
26
Simplified motion compensation circuit
27
2

Fig. 11

Fig. 10

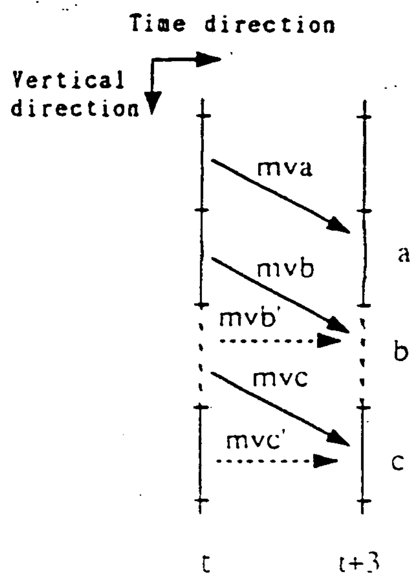


Fig. 12

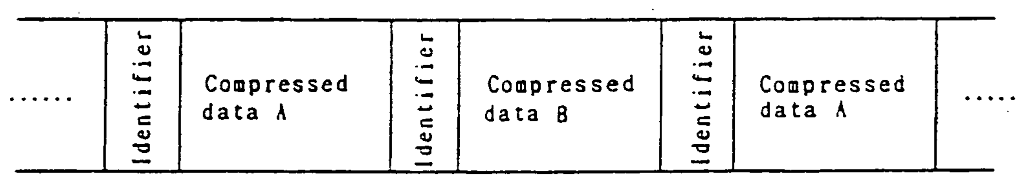


Fig. 13

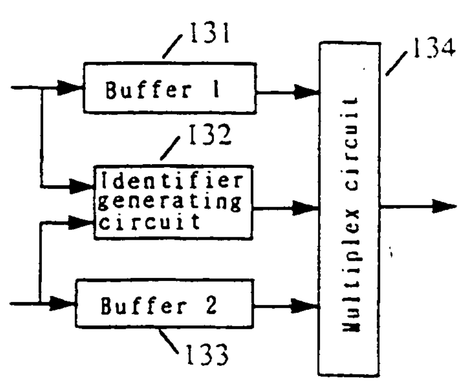


Fig. 14

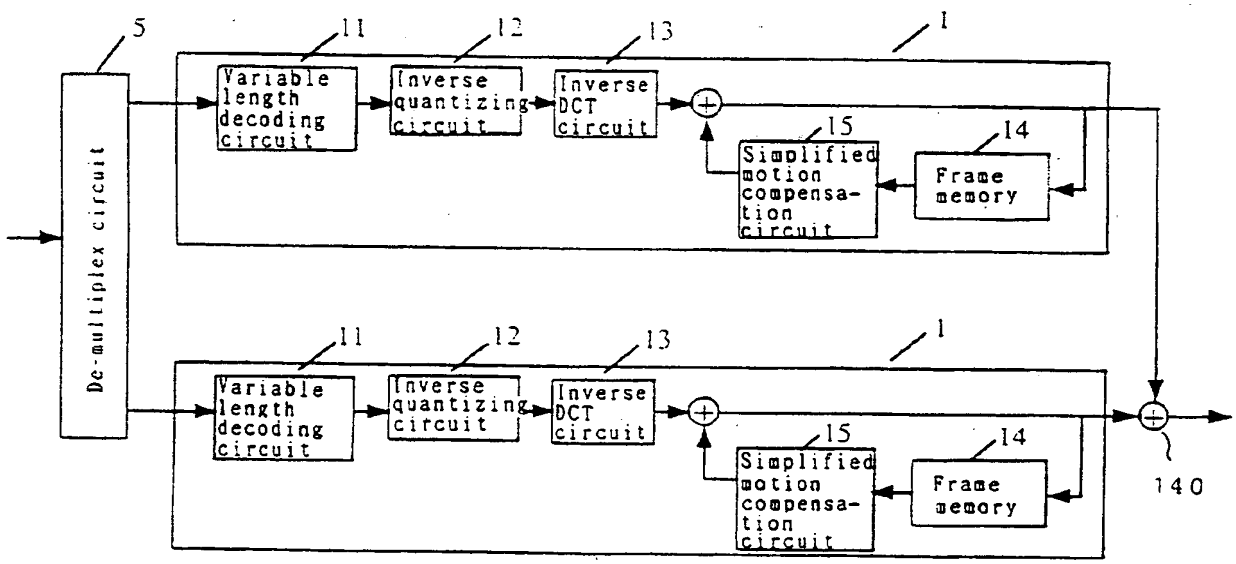

5
De-multiplex circuit
11
12
13
1
Variable length decoding circuit
Inverse quantizing circuit
Inverse DCT circuit
15
14
Simplified motion compensation circuit
Frame memory
11
12
13
1
Variable length decoding circuit
Inverse quantizing circuit
Inverse DCT circuit
15
14
Simplified motion compensation circuit
Frame memory
140

Fig. 15 PRIOR ART

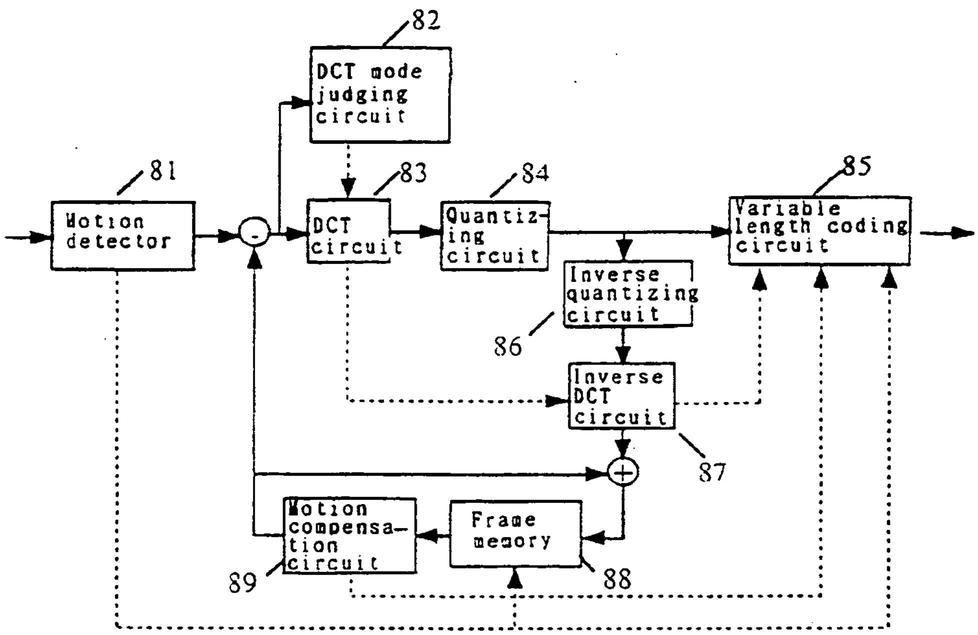


Fig. 16 PRIOR ART

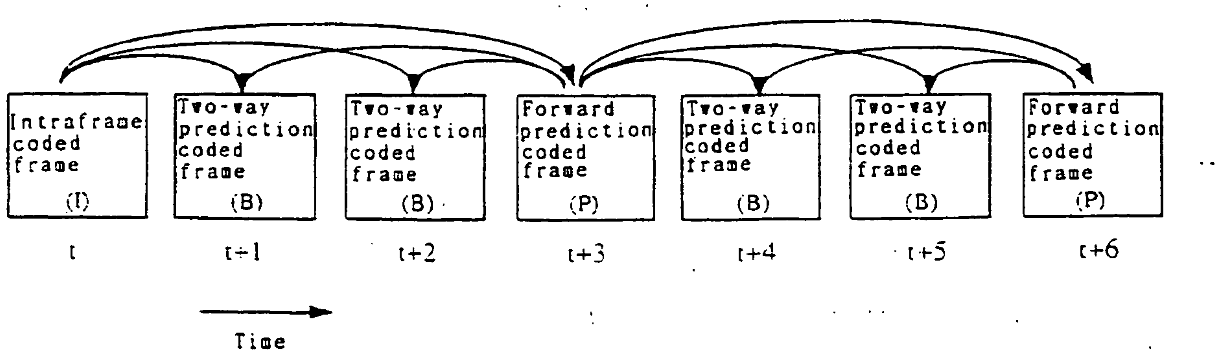


Fig. 17 PRIOR ART

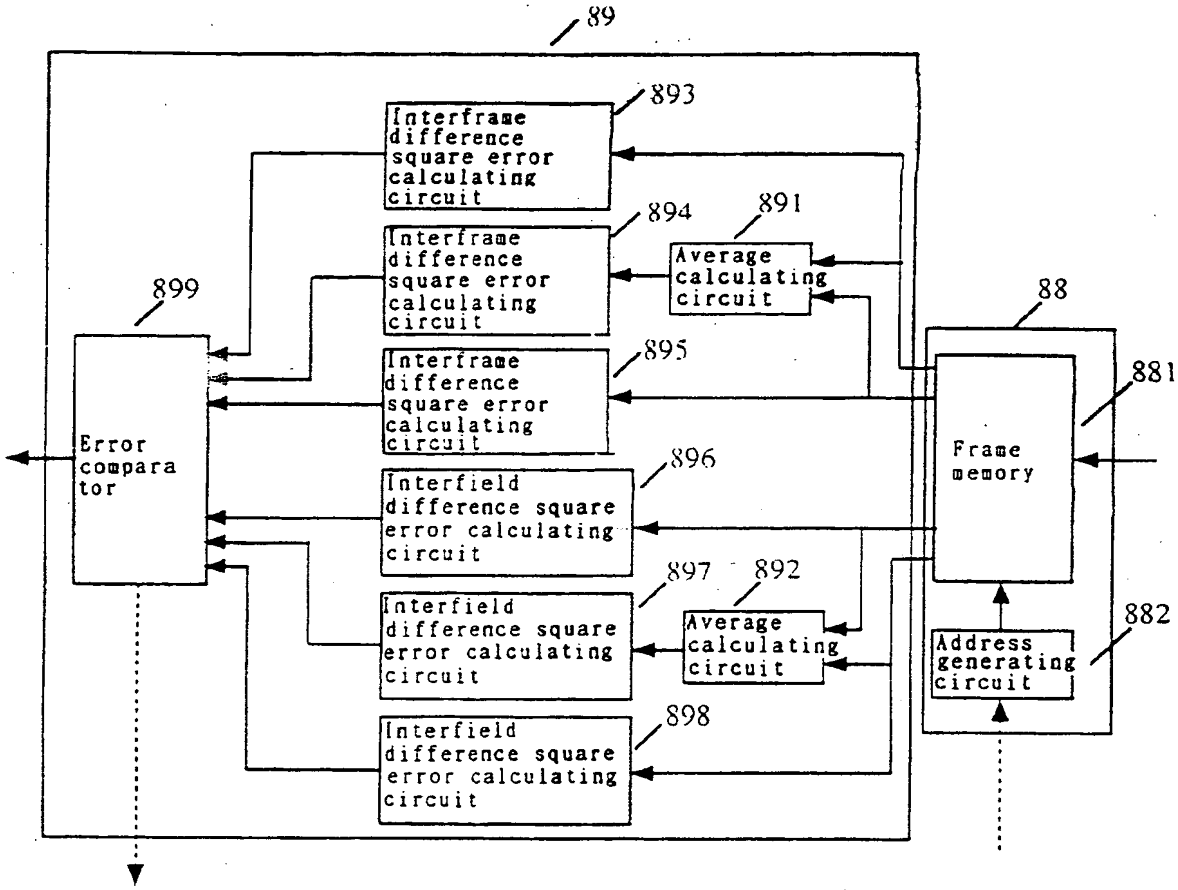
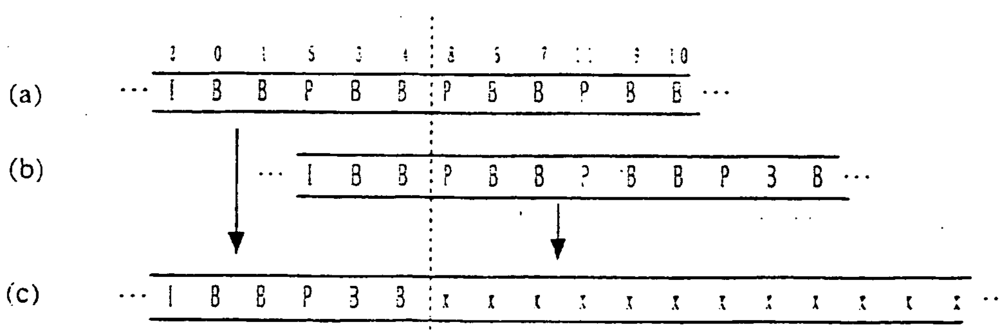


Fig. 18 PRIOR ART



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European Patent Office
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(71) Applicant: MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
Kadoma-shi, Osaka 571 (JP)

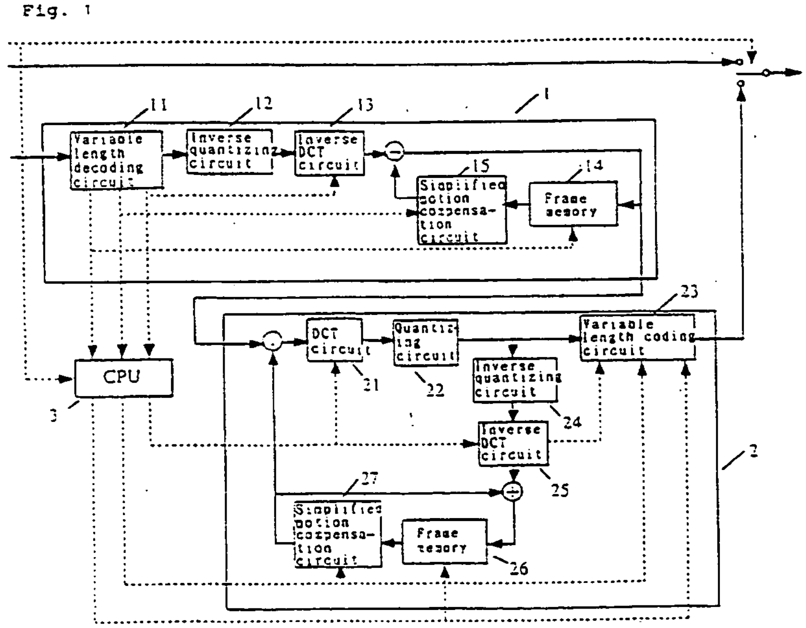
(72) Inventor: Takahashi, Toshiya
Takatsuki-shi, Osaka-fu 569 (JP)

(74) Representative: Crawford, Andrew Birkby et al
A.A. THORNTON & CO.
Northumberland House
303-306 High Holborn
London WC1V 7LE (GB)

(54) Method and apparatus for editing or mixing compressed pictures

(57) In editing first and second compressed picture data each having been obtained by prediction-coding, the second compressed picture data is modified by decoding a frame of the second compressed picture data at an editing point and re-coding the decoded data so that every frame around the editing point can be decoded after editing. The first compressed picture data and the modified second compressed picture data are liked to complete the editing. In mixing a compressed picture data with a non-compressed picture data. the compressed picture data is decoded and added to the non-compressed picture data to obtain a mixed picture data. The mixed picture data is re-coded to be a compressed picture data. In each of the editing and mixing, the re-coding may be performed by using at least one of the motion compensation information, motion vector information and orthogonal transform mode information which can be derived from the compressed picture data in the decoding process.

Fig. 1



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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 30 8669

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 456 433 (SONY CORP) 13 November 1991 ---		H04N7/58 G11B27/036 H04N5/926
A	US-A-4 969 055 (OBERJATZAS GUENTER ET AL) 6 November 1990 -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
G11B
H04N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 June 1996	Benfield, A

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